



## Article

# Contamination of Perfluoroalkyl Substances and Environmental Fight for Safe and Health: The MammeNoPfas Movement as Epistemic Community

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**Abstract:** Some communities in the Veneto Region (Italy) are facing a major technological disaster due to per- and polyfluoroalkyl substance (PFAS) pollution. In response to this serious problem, a group of ordinary mothers exposed to PFAS contamination came together under the name MammeNoPfas (MothersNoPfas) to address this environmental disaster moving towards activism. They started to develop the epistemic capacity to understand these substances and disseminate this knowledge within their communities. The purpose of this study was to explore the experience of these mothers as an epistemic community and a minority group, engaged in an accidental form of environmental activism. Based on in-depth narrative interviews, 23 mothers were involved in the study. A grounded theory and thematic analysis methods were used. Four major themes emerged: (1) health surveillance, (2) collective ignorance, (3) collective learning, (4) community practices. Nine sub-themes were associated with the emerging themes. This study demonstrated that the skills acquired by MammeNoPfas enabled significant participation in environmental and health issues. Social mobilisation, fighting for legal justice against those who poisoned their land and bodies and establishing themselves as an epistemic community are the three main dimensions characterising the struggle of MammeNoPfas.

**Keywords:** epistemic communities; social influence; minority group; empowerment; community practice; accidental activist; social movements; PFAS contamination; chronic contamination exposure; environmental risks



**Citation:** Menegatto, Marialuisa, and Adriano Zamperini. 2024.

Contamination of Perfluoroalkyl Substances and Environmental Fight for Safe and Health: The MammeNoPfas Movement as Epistemic Community. *Social Sciences* 13: 509. <https://doi.org/10.3390/socsci13100509>

Academic Editor: Nigel Parton

Received: 29 July 2024

Revised: 18 September 2024

Accepted: 25 September 2024

Published: 27 September 2024



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## 1. Introduction

In Italy, the recent discovery of a major technological disaster due to per- and polyfluoroalkyl substance (PFAS) pollution (WHO 2017), as well as the linked detection of health hazards for thousands of contaminated and exposed people (Menegatto et al. 2022), stimulated the participation of ordinary people at the local level. In particular, a group of mothers, named MammeNoPfas (MothersNoPfas), initiated an environmental project starting from their local contaminated community, mobilising other women (and some men) to participate in collective community action. This group was formed in January 2017, following the launch of a health surveillance programme by the Veneto Region to test PFAS exposure in residents in the ‘Red Area’.

PFAS contamination in the Veneto Region covers three provinces—Vicenza, Padova and Verona—with a maximum exposure area, named ‘Red Area’, of 595 km<sup>2</sup> and a total population of approximately 140,000 inhabitants. A factory named Miteni Group, located in Trissino, Vicenza Province, was identified as responsible for the disaster. For decades, since 1966, it had been releasing wastewater into the ground, contaminating both surface water bodies and groundwater, as well as domestic water.

PFASs comprise a large group of over 5000 synthetic fluorinated chemicals, part of which are currently being used in diverse products. Due to their high resistance to biodegradation, they have earned the title of ‘forever chemicals’ (Miner et al. 2021). They

are associated with several adverse physical and psychological health outcomes throughout the human life stage, including reduced kidney function, metabolic syndrome, thyroid disturbance, cancer, adverse pregnancy outcomes and chronic distress (Sunderland et al. 2019; Menegatto et al. 2022). The International Agency for Research on Cancer (IARC) recently confirmed the carcinogenicity of two molecules classified as PFOA and PFOS (Zahm et al. 2024). These molecules can be found in a wide range of products for human use, such as food packaging, carpets, building materials, cosmetics, cookware, waterproof clothing and firefighting foams. Furthermore, the association of PFASs with mortality from cardiovascular disease (in particular, heart disease and ischemic disease) and malignant neoplastic diseases, including kidney and testicular cancer, was recently demonstrated in the exposed population living in the contaminated area of the Veneto Region between 1980 and 2018 (Biggeri et al. 2024). For this population, Catelan et al. (2021) found a higher mortality rate for COVID-19 than the rest of the region.

Despite the knowledge of their toxicological and exposure concerns starting in the 1960s (Lyons 2007; Grandjean et al. 2017; Grandjean 2018; Richter et al. 2018) (e.g., the chemical industry in the United States was aware of the associated risks), these chemical compounds remained quite unknown to citizens and environmental health activists for a long time. This was due to the weak legal and regulatory systems that privileged industries and markets, producing pluralist ignorance among the public (Allport 1924; Richter et al. 2021; Wickham and Shriver 2021) and building imperceptibility regimes (Murphy 2006) for providing a justification for inaction. Also supported by their intrinsic characteristics, PFASs are invisible substances (colourless, odourless and tasteless) that created a completely altered perception in the population, who then fell into an obscure cone of knowledge and information.

In the United States, the dam was first broken in 1999 by a courageous family of farmers in Parkersburg, Virginia—the Tennants—after their cattle began inexplicably dying from a mysterious disease caused after the chemical company DuPont started disposing of PFAS-containing chemical waste next to their farm (Lyons 2007; Richter et al. 2018; Bilott 2019). With the help of a brave lawyer named Robert Bilott, the Tennants sued DuPont, and, subsequently, Robert Bilott organised a class action lawsuit representing approximately 80,000 exposed residents of the near Mid-Ohio Valley (Bilott 2013, 2019). This litigation imposed a series of medical investigations and epidemiological studies that resulted in the C8 Science Panel (2019), which linked PFOA exposure to negative health outcomes. It is from this period that the vast majority of PFAS activists and community members were mobilized (Ohayon et al. 2023). In Italy, the dam was first broken in 2017 with the mobilisation of MammaNoPfas, a group of ordinary mothers who were residents of the major contaminated municipalities, which led to the biggest environmental disaster trial in Italy's history until today.

In 2019, at the Department of Philosophy, Sociology, Education, and Applied Psychology of the University of Padua, the research group 'Social Psychology of Security and Safety' launched a multi-year research project (still ongoing) titled 'Community Health Resilience' (CHR) with the aim of analysing the impact of PFAS contamination on Veneto communities and developing group and community strategies to cope with this environmental disaster. Within the CHR project, this study aims to understand the process by which ordinary mothers have built an epistemic community, become activists through the experience of living in a contaminated land and developed the capacity to influence social change.

## 2. Environmental Issues and Epistemic Communities

The concept of community is problematic in both everyday discourse and academic research (Crow and Allan 1994; Schensul 2009). In general terms, a community is composed of various social actors (citizens, institutions, services) who share an important aspect of their lives—whether out of duty, pro-social behavior, desire, mandate, or solidarity—connected to their identity, and based on this, they live and organise their social bonds. More specifically, according to Campbell (2000), a community can be defined based on three dimensions:

sentiment, social structure, and space. The first dimension refers to the psychological, cultural, and symbolic processes that occur within individuals and the community. This dimension relates to what people perceive, feel emotionally, and develop/share symbolically in relation to the communities they belong to or wish to belong to. In other words, it refers to a sense of community, including shared values, norms, and meanings. From a socio-structural perspective, the community organises within itself the dimension of power, as well as roles, positions, norms, and values, which may already be shared or constructed through shared processes. Finally, communities are situated in a space, a geographically defined location, with boundaries and unique characteristics that impact people's lives. Place attachment (Fried 1982) and place identity (Proshansky et al. 1983) are some of the most significant aspects of this dimension. Building on Bavli and Steel's (2015) critique of epistemic communities, which calls for a clear definition of 'community', we will use the term community to refer to how communities are discussed, constructed, and defended by those who reside in or interact with them, and how representations, practices, and power dynamics both shape and limit the social construction of communities.

For Werkheiser (2016), what distinguishes epistemic communities from other types of communities is their ability to develop an epistemic capacity, that is, their ability to gain knowledge and participate in the production of information relevant to society, informing political decisions. These communities have been highlighted in the academic literature for their key role in the processes of knowledge creation (Haas 2015). In fact, they are at the origin of major changes and revolutions across various domains, whether artistic, technological or scientific. In the art world, they drive the creation of new styles and genres. In technology, they fuel new discoveries and breakthroughs. In science, they lead to the development of new disciplines, schools of thought, and fields of study. According to Werkheiser (2016), such capacity develops when communities face problems related to the environment with which they have had a relationship for thousands of years, especially at the local level, and are unlikely to be helped by dominant social institutions (Werkheiser 2014). In the context of environmental decision making, epistemic capacity has become a crucial component (Yosie and Herbst 1998; Beierle and Cayford 2002; Richardson and Razzaque 2006; Azlan et al. 2023). In fact, communities with epistemic capacities can become better partners with experts, making epistemic capacity an important part of science. Haas (1992) identifies four key characteristics of an epistemic community: shared normative beliefs, where members hold similar values that guide their actions; shared causal beliefs, meaning members generally agree on how the natural world functions and what actions or policies are necessary to achieve desired outcomes; shared notions of validity, with common criteria for assessing what constitutes valid knowledge; and a common policy enterprise, wherein members aim to apply their expertise to inform policies for the benefit of society. To evaluate the effectiveness of an epistemic community, one might consider its influence on policy, its engagement with the broader public, and its success in communicating its agenda (Stephen and Liu 2012).

Now more than ever, especially concerning environmental issues, the public is coming together in various communities to demand involvement in shaping policies and agendas and to call for transparency at all levels of decision making. Epistemic communities are easily identifiable within a growing contemporary environmental activism, where collaboration between diverse groups, such as citizens, business and state actors, leads to common goals in addressing the climate crisis (Skoglund and Böhm 2022). For example, they work towards decarbonization through a new level of actions, from small towns and villages to employees within various companies, all aimed at accelerating the energy transition. Consequently, it has become increasingly common for informed citizens to take local action to address environmental issues while demanding radical change on a global scale (Perkins 2019). Generally, these individuals become accidental activists, driven by a specific incident that impacts local life. They are often mobilized by a particular issue, which then inspires them to expand their activism to other matters of local significance.

### 2.1. Public Participation in Environmental Issues

In Europe, public participation in environmental decision making is recognized as a legal right, a principle proposed by the Aarhus Convention in 1998. One reason for its growing relevance is strongly connected to the current turbulent times (Felt et al. 2013) crossed by the so-called ‘wicked problems’, which open to frameworks characterized by volatility, uncertainty, complexity and ambiguity, accompanied by disillusionment with policies not up to the task of providing long-term solutions. That is, environmental issues such as toxic contamination, various genres of pollution, siting of hazardous waste facilities or climate-change-related questions (Freschi et al. 2023) are ill-suited to be resolved by an exclusively managerial approach with narrowly defined technical definitions and solutions, requiring broad-approach-based public participation. In this vein, public participation, together with epistemic communities, is placed within post-normal science (Funtowicz and Ravetz 1993; Werkheiser 2016), a model applied when facts are uncertain, values are contested, stakes are high and decisions must be made urgently, with the focus on including extended peer communities and multiple ways of addressing this situation by experimenting with new democratic forms. In practice, when a community of citizens organises around specific issues and forms through direct discussions, such as in the case of communities affected by chronic environmental contamination (Sullivan et al. 2021), relevant controversies may arise regarding public health problems with societal repercussions in the public decision-making arena. In such cases, public participation by these citizens can assist governments and agencies in understanding and identifying public interest concerns, thereby facilitating better decision making. Additionally, the participation of epistemic communities may promote environmental justice and improve the acceptability of environmental decisions, leading to fewer litigations, conflicts and delays, as well as the resolution of mistrust. Furthermore, strengthening epistemic capacity in communities can mitigate environmental stressors (Freudenberg et al. 2011). This is even more valid at the local level, where decisions result in local understanding and collaboration (Uittenbroek et al. 2019) and build the capacity to solve wicked problems of the future, considering the needs and social issues of residents at every stage of the planning process (Ghai and Vivian 1992).

In such situations, the public must acquire an epistemic capacity to participate meaningfully by articulating their values, beliefs and needs (Shrader-Frechette 2010; Werkheiser 2016). This can only be done at the community level. Note that the knowledge generated by epistemic communities is more than just an agreement on scientific beliefs or merely information production. Epistemic communities transform the body of knowledge by shifting it from theory to practice. They act as channels through which theoretical knowledge is applied to concrete and practical situations. The process is not merely a direct transfer of information but an ongoing interaction between science and society, where scientific knowledge is adapted and reinterpreted to address real-world problems. This transfer process implies that certain types of knowledge, once confined to a strictly scientific domain, are disseminated and made accessible to non-scientific communities. Epistemic communities filter and interpret this knowledge, adapting it to the cultural context and practical needs of its recipients, thereby helping to influence political, economic and social decisions. They adopt a pragmatist perspective in the form of knowing that requires active participation in communities where knowledge is bound with a series of actions and community processes (Wenger 1998). Practices form the fundamentals of what epistemic communities are, do and strive for. These communities have social and political relevance and recognized expertise, which confers them with authority (Adler and Haas 1992). This epistemic authority is explained through the adoption of the competence of doing and practising something by a growing number of practitioners in space and time (Adler 2019). It is precisely through practices that epistemic communities express their influence in determining a social change, because not only do they gain knowledge but also maintain, adapt and continue to spread it across different dimensions and areas (Werkheiser 2016).

## 2.2. Epistemic Capacity and Empowerment

The close connection between public participation and epistemic communities is expressed by a particularly relevant concept in psychology: the construct of empowerment (Labonte and Laverack 2008). It refers to the process through which people gain control over the factors and decisions that shape their lives, increase their assets and attributes and build capacities to gain access, partners, networks and/or a voice, in order to acquire varied forms of power. It assumes that people are their own assets, and the role of the external agent is to catalyse, facilitate or accompany the community in acquiring power. When public participation processes are activated through epistemic modalities, as the involved citizens develop epistemic capacities, they become empowered by enhancing their sense of self-control and acquiring power over their life. In fact, for communities, empowerment is not only involvement, participation or engagement but implies that their actions explicitly aim at social and political changes. Environmental issues add another relevant dimension to the community empowerment process. In today's world, the local and global contexts are inextricably linked because, as in the case of PFAS contamination, communities often decide to take local actions to promote change, increasing their influence. In particular, community actions, when they start to multiply frequently and connect across the globe, are the most viable and realistic approach to influencing change at both local and global levels. Epistemic capacity, therefore, plays a crucial role in ensuring community empowerment. Public participatory approaches in epistemic knowledge that promote discussion and debate lead to higher levels of shared knowledge, awareness and critical thinking. All of these are factors that allow communities to change the balance of forces operating on their lives, strategically acting upon this interlinkage at both local and global levels. Power and influence are central concepts in community empowerment, especially in the field of health promotion and wellbeing. This is particularly significant in the context where environmental problems negatively impact human health, causing diseases—often affecting large populations, such as in the case of PFAS contamination. This is also applicable to cases in which epistemic communities move themselves with the aim of finding the source of diseases in their territories. This last action taken by citizens represents a phenomenon called popular epidemiology (Brown 1992), which represents one form of epistemic community (Werkheiser 2016). In fact, people living in a local area are often the first ones to be aware of ongoing problems in their community. This is not surprising because, in their daily practices, these people can notice small indicators in the environment, individuals and animals that others would not see.

## 2.3. Minority Groups and Social Change

This article, so far, has shown the importance of epistemic communities (Shrader-Frechette 1991), from constructing collective knowledge and influencing social change to fostering public health, empowerment and collective growth—although, in some cases, they may appear as a minority group, particularly at the local level. According to the classical model of majority influence (Moghaddam 1998), any deviation from social norms is synonymous with deviance. Individuals who belong to this dimension are placed under supervision or on the margins of society due to transgressions or an inability to conform to norms, as they are overwhelmed by a condition of difference that translates into “minority” status. However, it is important to distinguish between deviance and minorities: the deviant, unable to promote an alternative normative perspective to that of the majority, is always defined according to the dominant criteria of the majority groups. Conversely, the minority rejects the label of deviance, opposing the majority and established authority and engaging in a struggle to avoid being silenced.

From a social psychology perspective, minority groups have historically played an important role in successfully instigating political, scientific, religious and artistic changes (Moscovici 1976). According to Moscovici (1976), they are called counternormative groups because they challenge or contradict the prevailing norms and beliefs in society. Their influence does not stem from their numerical size but from their ability to articulate and

disseminate an alternative message. They play a crucial role in promoting social change and restructuring existing norms. Past examples can help us understand when minorities have changed the majority opinion, such as the suffragettes' battle for women's rights, the movement for Black civil rights in the United States for emancipation and the health movements for closing asylums to recognise the dignity of patients with mental health issues. Recently, minority groups have increasingly concentrated their efforts on pressing issues like climate change (Bolderdijk and Jans 2021) and pro-environmental concerns (Avery and Butera 2022). These groups have emerged as significant epistemic interlocutors, meaning they actively engage in discussions and influence the understanding and dissemination of knowledge related to these critical topics. According to Moscovici (1994), minority groups exert their influence through vigorous advocacy, preserving a behavioural style characterized by temporal consistency, internal consensus, autonomy, fairness and investment in their position, even at the price of reprisals. In this vein, minorities represent a force that cannot be long ignored but is gradually recognized. Moscovici emphasized these behavioural styles, as they affect the attribution that change goals make about sources of social influence.

The behavioural styles proposed by Moscovici can help us better understand how the four necessary conditions for the epistemic capacity of communities—acquisition, maintenance, adaptation and development of knowledge—proposed by Werkheiser's (2016) can be applicable in practice. Some community characteristics, such as sharing a severe environmental problem like chronic PFAS environmental contamination and parents being concerned about their children's health (Menegatto et al. 2022), can make members better establish collaborative relationships, understand each other and work together to distribute knowledge about the problem within the community (Bavli and Steel 2015). Additionally, similar to minority groups (Papastamou and Mugny 1985), epistemic communities also negotiate their knowledge (Werkheiser 2016) in a flexible manner with the targets of their instances, showing levels of openness and adaptation in acknowledging their and others' positions.

### 3. Women and Environmental Risks

Women are often related to the processes of minority groups and community-based movements for health, partly because they are mainly responsible for the health of their families, particularly vulnerable members (Menegatto et al. 2022). According to Brown (1993, 2007), it is often women who first notice potential problems in their communities. For them, the impacts of environmental hazards on people and relationships are more significant than the abstract criteria of traditional science. The presence of women in environmental movements has been well documented. Across countries, women express greater concern for the environment and are more likely to act pro-environmentally than men (Zelezny et al. 2000). This difference is attributed to their distinct life experiences, which heighten their awareness of issues such as the impact of pollution on children's health (Grasso and Giugni 2022). Women are often the first to experience chemical trespass into the private sphere of their homes, their bodies and their children's bodies. They live with the fear of getting sick and constantly worry about spreading their infection to their children (Menegatto et al. 2022; Menegatto and Zamperini 2023). Biologically, studies have suggested that female bodies are more susceptible to environmental toxins. For example, certain groups of fat-soluble toxic chemicals (such as dioxins) bioaccumulate more easily in women, who tend to have higher fat ratios than men (Buckingham and Kulcur 2009). In the case of PFASs, mothers pass on the toxic substances to developing foetuses through the placenta and onto babies through breast milk (Mamsen et al. 2019). This shows the complex relationship between gender biology and socially determined environmental conditions that can amplify or mitigate the impact of environmental harm and risk perception.

Another notable consequence that can be equally problematic is that women face social pressure to be good mothers who protect their children (Auyero and Swistun 2009). Mother blaming occurs when people preserve the belief that mothers are primarily responsible

for the safety, wellbeing and care of their children (Strega et al. 2008), even when they themselves are victims. This process is also called secondary victimisation, which often affects both the direct victims (i.e., the children) and the indirect ones (i.e., the parents, especially mothers). This practice shapes the actions of not only doctors, journalists and, in general, community members but also key legal decision makers, including prosecutors, judges and jurors (Fentiman 2017). For instance, in a lead-poisoning tragedy in the United States of America, mothers of lead-poisoned children were blamed for not supervising their children more scrupulously (Rosner and Markowitz 2008). In another case, Argentinian mothers who lived with their children in a flammable suburb (a town surrounded by a large petrochemical compound) had to face the stigma of being 'bad mothers' in their neighbourhood (Auyero and Swistun 2009). In addition, poor women and women of colour who have children with asthma are often held responsible for their children's illness when public health officials focus on indoor household triggers, such as dust mites, cockroaches and mice (Sze 2004).

In this way, attention and responsibility are shifted to mothers rather than corporate malfeasance, inadequate government regulations or systemic failures (Sze 2004). Another defensive strategy that members of majority groups adopt in response is ridiculing, dismissing, distorting or downplaying mothers (Kawamura and Kusumi 2020; Prislina 2022) or triggering negative stereotypes (Bashir et al. 2013; Brough et al. 2016), such as cold, lesbian, unhygienic, men haters or practising health ostracism (Menegatto and Zamperini 2023), preventing concerned mothers from accessing health programmes and biomonitoring.

#### 4. MammeNoPfas

In 2016, when a group of Italian mothers learnt that they had been exposed to toxic chemicals for decades and their children had high PFAS levels in their blood, they were concerned about their children's health. At the time of the contamination's discovery through human biomonitoring, there was limited knowledge in the impacted community and no shared knowledge base on which residents could rely. At the community level, information was ambiguous, negligible and full of contradictions. Shocked at the discovery, a few worried and angry mothers joined to share the pain. They then decided to stay together to respond to the crisis (Menegatto et al. 2022). Their anger was replaced by a resolve to make changes as mothers and citizens. The first urgent need was to understand what was happening, how such serious toxic contamination could happen and the consequences for them. Thus, they began to study all available documentation through formal or informal sources to gain information, share it and reach a mutual understanding. The Internet was the first channel of their research. After this process of acquired knowledge, the group began to take form in early 2017. They started to meet their representatives in the institutions (local mayors, regional councillors, president of the Veneto Region and Minister of the Environment), calling them to acknowledge and remedy what they perceived as a process of wrongdoing and negligence. Their goal was to collaborate with established organisations and authorities to tackle the problem effectively. By working together with these institutions, they sought to leverage resources, expertise, and influence to achieve a more significant impact. They started gaining increasing facts about the disaster and informing the inhabitants, creating opportunities for sharing knowledge, a process in which they have moved as a group of knowledge-driven agents linked together by a common goal, a common cognitive framework, common needs, feelings, hopes, spaces, a shared understanding of their commitment and a history which makes them feel part of a single whole (Sarason 1974). Second, they connected an informal audience of citizens with formal institutions. The informal audience characterized the bottom-up level, which is not immediately linked to the top-down level of the institutions but, in this case, plays an important role in generating new knowledge and to make parts of a larger community interact with each other.

In May 2017, the mothers participated, along with their children and 2000 people, in the March of the Flower. Symbolically, the flowers represented their children and

babies as the first victims of contamination. The mobilisation took place in front of Miteni Company to claim access to safe, contaminant-free water. During this period, the mothers continued to gather information and share it with institutions and citizens by meeting various chemical experts, academic researchers, parish priests and bishops. They also found support from the Holy Father Pope Francesco, who expressed his solidarity. They organised hundreds of meetings and sent numerous letters to Miteni Company. In these communications, they included blood test results of their children and reports on the contamination levels detected in their private wells. Their efforts were aimed at publicly disclosing the adverse conditions faced by the residents and pressing for action. Through these extensive interactions and documentation, they sought to raise awareness about the environmental and health issues affecting their community.

At this time, they conducted hundreds of meetings, sent many letters to Miteni Company with the blood reports of their children, as well as the reports of the contamination level found in their private wells, to publicly report the condition of residents.

In October 2017, the mothers organised the first big public mobilisation with the participation of more than 10,000 people and the patronage of 120 municipalities. On this occasion, they brought in lawyer Robert Bilott, who had previously fought and won against DuPont. At the municipal theatre of Lonigo in Vicenza Province, Bilot spoke publicly to the citizens about his experience regarding PFAS contamination and how the two events in the United States and Italy were similar. As a result, the Veneto region imposed regional limits of PFASs in all forms of drinking water, and the distribution plant managers upgraded the filters installed in 2014 for the water supply. Today, MammeNoPfas comprises hundreds of mothers within the 'Red Area' and is the only civil society accredited with these Italian legislative institutes: the Conference of Services and the technical table of the ministry. Thanks to the efforts of this group, the trial against Miteni Company started in 2021 in Vicenza to obtain justice and compensation.

Despite these series of mobilisations, which had characteristics similar to those of traditional social movements, these mothers were considered accidental or circumstantial activists because they adopted activism due to a series of their life circumstances (Arrington 2016). In contrast to 'lifelong activists', they neither had any prior activism experience or political ambitions nor were they 'ideologically aligned'. Instead, their life circumstances contributed to them becoming emotionally engaged and involved in campaigns of local importance and national and international concerns. However, their activism was far from accidental once they mobilized, particularly in terms of the results they achieved. This group did not stop at the complaint but remained unanimously focused on their rights, the search for truth and redress. They told poignant stories of personal suffering and tried to frame their causes, arousing moral outrage or a similar victimisation with bystanders, to prevent similar events in the future.

In Italy, MammeNoPfas is not an isolated case of a group of mothers who became accidental activists in the environmental field. Recently, many groups of women, especially mothers, have been fighting against pollution or waste mismanagement (Ledda 2018). Most well-known minorities originate from the north of Naples, where illegal dumping and burning of toxic waste earned it the infamous name of the Terra dei Fuochi (Land of Fires), or from Tuscany, where the Mamme No Inceneritore (Mothers No Incinerator) operates for waste mismanagement. These are associations and movements of mothers who, through a nationally and international organised network, are socially committed to defending the environment from pollution and climate change (Cohn and Duncanson 2020; Freschi et al. 2023) as well as pursuing goals of peacebuilding and reconciliation (El-Bushra 2007; Zamperini et al. 2017).

## 5. Materials and Methods

### 5.1. Purpose and Perspective of the Study

The present study continues the development of a mixed method community health resilience (CHR) research project started in 2019 (Menegatto et al. 2022; Menegatto and

Zamperini 2023; Zamperini 2023; Zamperini and Menegatto 2021), based at the University of Padova (Italy) (FISPPA Department). It is designed to investigate the impact of PFAS chronic environmental contamination (CEC) (Sullivan et al. 2021) among exposed residents of the Veneto Region.

In this article, our aim is to explore the experience of a group of exposed resident mothers engaged in an accidental form of environmental activism, formally joined in the MammeNoPfas movement as an epistemic community. The implications of this approach extend beyond mere theory. To illustrate this, we consider the MammeNoPfas group as a community of practice within the environmental context of PFAS chronic exposure contamination. This group will serve as a case study to demonstrate its epistemic potential and its influence through the knowledge it has accumulated and the practices it has implemented. This will allow us to focus on a knowledge that is practiced, that requires active participation of communities in the process of knowledge and is not a mere product but is bound with action (Wenger 1998). Second, these actions participate in transferring knowledge towards the ongoing practical activities of adaptation, maintenance and also reinterpretation in a flexible behavioral approach according to Moscovici (1976). From this perspective, in this article, we adopt community practice as a theoretical framework that underlies a particular model of learning, namely, learning in which people, through a process of participation, take up membership in and identity with a community, which serves as the home of these shared practices (Hoadley 2012).

### 5.2. Participants

Twenty-three mothers, members of the MammeNoPfas group, took part in this study. They were recruited through a combination of purposive sampling, based on our multi-year CHR research project and extensive contact with community members, and snowball sampling, where interviewees were asked to suggest other potential volunteer participants. To be eligible, the general inclusion criteria for the study were mothers of the MammeNoPfas group, residents of the contaminated area and aged over 18.

Mothers ranged in age from 39 to 62 (Mean = 50.39; SD = 6.81);  $n = 22$  participants were married and  $n = 1$  was single. All were parents of at least 1 child and a maximum of 5. Concerning the children of the participants,  $n = 24$  were under 18 years old, ranging in age from 1 to 18 (Mean = 11.83; SD = 3.55), and  $n = 24$  were over 18, ranging in age from 19 to 35 (Mean = 24.25; SD = 5.08). All participants came from municipalities located in the 'Red Area', where they had lived an average of 36.36 years, ranging from 10 to 60 years. Nobody declared themselves an activist before the experience of MammeNoPfas.

### 5.3. Research Instrument and Data Collection

The interviews were semi-structured, guided by a pre-established set of topics. This approach allowed for flexibility, enabling the interviewer to adapt and expand upon the questions based on participants' responses. The format encouraged participants to share their personal experiences of being part of the MammeNoPfas group, fostering a more in-depth and nuanced understanding of their involvement. Questions and prompts aimed to focus discussion on the following areas: (a) contamination discovery and their reaction; (b) how human biomonitoring was carried out; (c) how they decided to meet the group of mothers; (d) relationship with institutions; (e) relationship with community members; (f) family relationship. Each interview began with 'the moment', that is, the first time that each mother learnt of her child's contamination. To build rapport with interviewees and encourage openness, researchers took some time for an informal chat with participants before starting the interview recording.

All interviews were conducted via Zoom video conferencing (see Archibald et al. 2019; Bonisteel et al. 2021). All in-depth interviews lasted between 30 and 40 min and were audio- and video-recorded and transcribed verbatim; participants reaffirmed their consent verbally and in writing before the online interviews were conducted and completed a brief socio-demographic questionnaire. We obtained written informed consent from all

participants prior to the online interviews. This study followed the American Psychological Association Ethical Principles of Psychologists and Code of Conduct and the principles of the Declaration of Helsinki and was approved, together with the entire CHR research project, by the Ethics Committee of the Università degli Studi di Padova (Protocol Number 1D4BA484CC28FCDA6984C4F21E59DEA6).

#### 5.4. Data Analysis

We used thematic analysis (Braun and Clarke 2006, 2022; Terry et al. 2017), a qualitative method that provides rich, detailed and complex accounts of data. After familiarizing ourselves with the content of the transcripts, we constructed a mixed inductive and deductive coding matrix through the selection of text parts, named quotations; thereafter, codes were grouped into categories and categories into themes. The thematic analysis was conducted by two of the researchers (MM and AZ). Initially, the transcripts were reviewed independently. Later, the researchers met to discuss common themes they had identified and developed a coding framework. This framework was then applied to the remaining transcripts, using the qualitative software Atlas.ti 9.1.7. The process was iterative, and researchers regularly discussed any new codes that they identified that had not been captured in the original coding framework. When all transcripts had been coded, MM and AZ reviewed and discussed the coding framework to ensure that the themes were representative of the data. The final themes and their organisation were discussed among the whole research team. A thematic structure was developed with themes and sub-themes.

## 6. Results

### 6.1. Themes and Sub-Themes

Following the analysis of the data, all findings were organised to reflect 4 major inductive and deductive interrelated themes emerging from our analysis: (1) health surveillance, (2) collective ignorance, (3) collective learning, (4) community practices. Nine sub-themes were associated with the emerging themes. Table 1 depicts the themes and sub-themes generated from the data.

**Table 1.** The themes and sub-themes that emerged.

Themes	Sub-Themes
Health surveillance	Invitation letter
	To be mothers of contaminated children
Collective ignorance	The beginning
	Stigma
Collective learning	Mutual support
	Expert citizens mums
Community practices	Mobilization
	Legal arena
	Epistemic community

#### 6.1.1. Health Surveillance

This theme emerged when the mothers answered the first question, describing the health surveillance programme as a significant life event that contributed to their activism, which initiated their knowledge development and activated a chain of mobilisation events. According to the analysis of the transcripts, this process appears as a progressive series of growth and transformation practices punctuated by several life circumstances. For example, the programme showed two instances in which mothers played an active role in their determination to learn more. The first was an invitation letter in which all mothers reported an initial perception of a ‘strange situation’ (M.1), in which they came across environmental pollution terms they had never heard before, such as PFAS. The second, and more critical, instance for each mother was when the blood reports of their children showed high PFAS levels. They still remember that moment as if ‘it was yesterday’ (M.2)

due to the high emotional impact. Each mother remembered the life circumstances in which their child was subjected to medical checks without being able to receive exhaustive explanations. For example, a mother described a shocking incident in which, during a clinical session, the doctor used the term 'family disease' (M.14) to indicate the genetic cause of the high cholesterol levels found in her 23-year-old daughter without knowing that the girl was adopted. Another mother stated her discomfort when the doctor assured her that 'it is normal' (M.4), describing her 16-year-old daughter's high cholesterol levels, an outcome that did not make sense in a physically active young girl. In general, all mothers wanted to support the programme to learn more. The following sections illustrate in more detail the sub-themes that emerged, in which the participants described the beginning of their discomfort.

#### Invitation Letter

For each mother, the process began with the announcement of the programme, launched by the Veneto Region in 2016. All mothers unanimously affirmed that they 'received the same letter and the same treatment' (M.8). They described that the invitation letter was sent to the inhabitants of the Red Area, explaining the motivation and scope of the investigation. Considering the situation of environmental pollution, mainly of water, linked to PFAS contamination, the Veneto Region decided to implement this programme to evaluate human exposure to these contaminants and to determine whether it constitutes an additional risk factor for certain chronic diseases, with the goal of preventing them. The programme, which was completely free of charge, included blood sample analysis, urinalysis, blood pressure measurement and an interview to assess lifestyle and environmental risk factors. However, one mother expressed feeling unsettled by the letter, stating, 'there was something disturbing, and I felt unsafe,' as she continued to describe her perception:

In practice, the way the letter was written gave me the impression that it was a routine analysis, with no alarmist tone, even if the PFAS effect was clearly reported to be little known, yet they could develop chronic pathologies, particularly when combined with an unhealthy lifestyle. The letter provided minimal explanation, but gave us an appointment with no waiting list or fees, which is unusual in our healthcare system. It also included a dedicated phone number to reschedule if needed. For me, this made it feel urgent, even though they didn't explicitly say so. It felt like something serious was being withheld. (M.15)

A sense of uncertainty, concern and curiosity began to grow among the mothers, who struggled to understand the gravity, particularly because the first calls were directed only at a specific segment of the population, the adolescents, as a mother reported:

There were some concerns and uncertainty because everything seemed unclear, so I told my children to participate in the programme, even though it wasn't mandatory. I was curious to understand what was happening, especially to protect my children from any potential danger. (M.21)

This health call 'sounded strange' to all interviewed mothers. 'I realized that something was wrong if the Veneto Region called everyone' (M.1), stated a mum, and 'It didn't understand if the cause was the environmental pollution or our lifestyle' (M.13), stated another mother. Some mothers autonomously 'wanted to go down the question' (M.3), as described in the following segment:

I immediately went online to search for the regional guidelines regarding this programme. I read through all the regulations and the decree issued by the Veneto Region; the questionnaire we would complete during the blood test was also part of the administrative proceedings. Initially, I discussed it with my daughter, who was in Holland at the time, and later with some acquaintances. It became clear to us that the situation was much more serious than we had initially thought. (M.4)

Meanwhile, the mothers began to independently collect information about the programme by consulting institutional administrative documents online. This demonstrated their ability to expand upon the limited knowledge they initially received. As one mother noted: 'To my knowledge, we were few mothers to go beyond what was written in the letter, we were uncomfortable, and we acted on the basis of insight' (M.10). All interviewed mothers decided to participate in the programme, encouraging their children and other family members to do the same, with the goal of gaining a deeper understanding.

#### To Be Mothers of Contaminated Children

In 2017, two months after receiving the invitation letter and the first medical examination, the biomonitoring results began to be delivered to the inhabitants, some through ordinary mail, as described by a mother: 'The results arrived at home by mail, so each mother opened the envelope and read the analysis on her own' (M.8). All interviewed mothers declared that they did not receive sufficient information from the healthcare professionals during the checks or professional support to interpret the results, as mentioned by a mother who was also a nurse:

From a nurse's point of view, I understand they are doing their job and following protocol, which includes not causing alarm. However, it seemed to me that they were downplaying the situation too much; they simply told me everything was fine. But a value that is 20 times the allowed limit is far from reassuring! You can tell us that, for now, there are no pathologies, but from the results, they should have informed us about the severity of the issue, especially since it was a case of chemical contamination! In hindsight, the serious consequences of the PFAS contamination were already known. (M.5)

Comprehending that something was wrong and perceiving a lack of healthcare support, the mothers continued to be deeply concerned about their children, reporting a sense of uncertainty and anger arising from the lack of information. Many questions also characterized the mothers' thoughts, as some news began to circulate in the community through word of mouth: 'When you first learn your child is contaminated, immediately you are catapulted into another world. So, what do we do now? Who is the cause? And what are the consequences? What can happen? What can we do?' and 'I was angry because we couldn't make sense of all' (M.11).

Additionally, the interviews showed a questioning of their maternal role in terms of their children's lifestyle through the questionnaire filled out during the surveillance programme. Most of the mothers reported that the one thing that greatly struck them was a common outcome: 'It was written: the lifestyle can be improved. But I wondered what we must improve?' (M.22). For them, it was another unclear element, as illustrated by this mother:

It felt as though the healthcare professionals were implying that if a negative health outcome emerged, it was due to our lifestyle choices. They stated: 'We recommend reviewing your lifestyle to reduce the likelihood of developing chronic diseases in the future.' But my son did not smoke, did not drink alcohol, played football three times a week, and we followed a balanced diet as a family. . . In the end, it seemed like they were blaming me, as if my child's lifestyle was wrong and he was at risk of serious illness because of it. . . (M.14)

The emotional experience of these women was reported in the form of their increased anger, as indicated by a mother: 'in this way, the cause of PFAS contamination was shifted from a public issue to a private problem, which made us even angrier' (M.17).

#### 6.1.2. Collective Ignorance

This theme is directly related to the widespread collective ignorance about PFAS contamination that persisted in the communities. The respondents learnt about the contamination when their children were recruited for the health surveillance programme,

and their blood results clearly showed high PFAS levels. The only information they received was described in the invitation letter as 'environmental pollution', and they never anticipated such severe toxic contamination. Therefore, all mothers were motivated to access as much information as possible, especially because they wanted to know about the health consequences. However, within the communities, the respondents received mixed messages with negligible, confusing and sometimes contradictory information from various contacts, including local health authorities. For example, one mother expressed astonishment at the lack of information provided by her family doctor when she came with the blood results: 'My doctor absolutely knew nothing. Indeed, he asked me to be informed regularly' (M.16). The local priests also did not know anything. In addition, numerous community members who were not eligible for the programme because they either fell outside the target age range or did not have teenage children received no information on the situation. Furthermore, among the participants in the health programme, 'no brochures or materials were distributed to properly explain the situation' (M.18), as reported by an interviewed mother. The respondents also expressed dismay at some of the responses from their municipality when they sought information on contamination. For example, a mother described contacting an official to enquire about the contamination of her water: 'The response was to remain calm because he told me "In your opinion, if I had known that the water was contaminated, I would not have allowed the preschool children to drink tap water!"' (M.20). Thus, the widespread collective ignorance about PFAS contamination produced overwhelming feelings of shame and guilt among the mothers when they posed questions to obtain more information.

### The Beginning

The mothers in this study defined the events related to the health surveillance programme as a first great transformative experience because 'from there everything changed' (M.2). In fact, they realized that this programme helped them gain a deep understanding of the situation, especially because it primarily affected their children. In this phase, their epistemic capacity to face collective ignorance in terms of their role as mothers started arising spontaneously, united from a common need to be good mothers and good citizens, as reported in the following extract:

At first, we were four concerned and angry moms. Suddenly, we came together to share our discomfort. Our anger was soon replaced by the need to do something as mothers and citizens. The first need was to understand what had happened. From there our story begins. (M.23)

It is exactly from this point that they began studying all available documentation, discovering that it was the third largest technological environmental disaster worldwide and demonstrating a capacity to gain knowledge. Their accidental activism mainly emerged in the spaces these mothers inhabited, starting with meetings in their kitchens and homes for sharing knowledge:

Initially, we met at one mother's home. She graciously offered her kitchen, which made it very comfortable for us. Some of us prepared cakes and fritters to share, creating a welcoming atmosphere and encouraging collaboration. Over time, our group grew to 20–30 concerned mothers, all gathering in the Giovanna's kitchens! At one point, we invited the director of a major environmental agency, and he came to Giovanna's home to speak with us. (M.8)

Since the beginning of the health programme, the mothers started taking the first step into the complex world of environmental contamination issues. For them, the knowledge gained initially has been enhanced and has now become a continuous process in their lives.

### Stigma

The mothers reported they faced negative treatment from others. Most of the interviews revealed experiences of interpersonal stigma, such as being laughed at, doubted,

verbally accused of alarmism and labelled as ‘chemistphobic’ (M.6). Speaking out about PFAS contamination, asking publicly for updates on filters or advocating for land reclamation became significant sources of stigma.

The mothers often experienced stigma from their neighbours or community members and felt minimized by language that referred to them as ‘prima donnas’ (M.6), ‘crazy’ (M.12), ‘overly concerned’ (M.9) and ‘terrorists’ (M.1), as stated by a mother: ‘they told us we were exaggerating, and we did terrorism, often making me feel guilty’ (M.17). There were instances of leaders being irritated by their presence: ‘When some mayors saw us, they said: here are the mothers! Now they do everything, they solve any problem! These lines deliberately said by a representative of the institutions hurt us’ (M.22). In the work context, a mother reported the following: ‘From the former colleagues, especially managers, I often felt snubbed. I heard them talk to each other about us with these comments like “of course! What do they know more than so many luminaries?”’ (M.19). In addition, during clinical sessions, some health professionals made them indirectly feel as ‘bad mothers’ (M.10) for not being able to give their children an ‘improved lifestyle’ (M.10). When the mothers started meeting regional and health leaders, they felt delegitimized by attitudes that dismissed them as ‘silly’ (M.5) when they expressed strong concerns. In general, they felt upset, marginalized and disappointed. They often found themselves a lone voice in advocating for a ‘broader view of events’ (M.2).

### 6.1.3. Collective Learning

This theme emerged when the mothers described their process of starting learning and coordinating as members of a newly formed group, such as MammeNoPfas. A few months later, they noted something unclear about what was happening. ‘Every mum for herself noticed something was strange, we started that we did not understand anything, we put together so much knowledge, united many pieces before separated, we share information, creating a common perspective’ (M.14).

In the absence of clear answers, some mothers also found it difficult to discuss PFAS contamination and inform other community members about something that they did not understand; the mothers addressed the issue of collective ignorance by engaging in collective learning. They worked together to acquire knowledge and understanding about PFAS contamination, with the goal of either resolving the situation ‘or, at the very least, gaining clarity on the matter’ (M.11). This collaborative approach helped them better navigate and communicate the complexities of the issue. Here, this is understood as the epistemic capacity to acquire knowledge, exchange different perspectives by adapting to the knowledge, question well-established perspectives and integrate this knowledge from time to time. This epistemic process emerged from the interviews as recursive, that is, the knowledge generated is not forever given, since the mothers reflect on the acquired knowledge, revising and continually deepening it.

I began studying extensively. I learned to understand technical terms and documents, reached out to many people, and received support from educated friends who helped and guided me through these challenges. Today, I have about 15 folders filled with scientific reports, administrative documents, and more. Whenever I encountered something I didn’t understand, I took notes and sought to improve my knowledge. I cleared off my painting table, which has now become my study desk. I stay at my desk while the rest of my family listens to music or watches television. I study with headphones. Yesterday, I studied seventy pages of documents, I took notes, and checked for any concepts I didn’t understand. I then delved deeper to clarify those points. Finally, in the evening, I compare the results with other mothers. Why all this effort? Because we needed to acquire and share knowledge. Because when we meet with public institutions, we need to be well-informed and know what we’re talking about. (M.12)

The mothers learned about PFAS environmental contamination from diverse sources and disciplines. In particular, the mothers came from diverse backgrounds with no prior ed-

ucation about PFAS or chronic environmental contamination. The following is an example given by a mother who described the disciplines and the methods she adopted for learning:

We study materials on PFAS across a broad range of field including chemistry, economics, geology, hydrogeology, medicine, and epidemiology. Thus, concepts must be explained and discussed repeatedly, and we need to study them deeply and organize the information correctly. It's a complex process that often keeps you up all night studying and reading. I've learned that dealing with PFAS contamination can only be accomplished through knowledge. (M.23)

Throughout 2017, the results of human biomonitoring continued to be delivered to the inhabitants of the Red Area, and the group of mothers continued to grow. Across the Red Area, other concerned parents with contaminated children began joining mothers in their meetings, which initially started in Lonigo. Although some fathers were also present, it was primarily mothers who founded and participated in this group, seeking knowledge and mutual support. A mother shared the following fragment: 'I immediately admired their approach, characterized by a respectful and open culture, the ability to mediate, a typically female strength, and the absence of political ambitions. I felt that we could achieve something together. This has strengthened me as a woman, a mother, and a citizen' (M.20). Thus, it was the mothers, residents of various municipalities in the Red Area, who started to organise local groups across different municipalities.

#### Mutual Support

A small group of mothers with contaminated children began meeting to share experiences and mutual support. The direct contact with other mothers was particularly valuable, fostering significant relationships and providing crucial support. A mother, reflecting on the experience of receiving the blood results, stated:

There was no help from the medical professionals or the mayors. We had to confront the facts on our own. We met, learned together, and supported each other. As our group grew from a few mothers to many, we discovered that we could share not only information but also our concerns, difficulties, insecurities, questions, and doubts. We received answers, advice, and understanding from one another. (M.2)

Another mother said:

Many of us were working, so initially, those with more time did what they could. We supported each other. Over time, we learned to organize ourselves into groups based on our strengths and interests. For example, we have a group for fundraising, one for managing social media, and another for connecting with other groups and organizations, among others. (M.7)

Collectively, the mothers reached out to each other to take common action, paving the way for mutual support. Gradually, more mothers joined the original group, not only to achieve their goals but also to share concerns and interests with like-minded individuals. Over time, they learned to help each other organise tasks more effectively.

#### Expert Citizen Mums

The mothers gathered considerable scientific data and seized the power of knowledge sharing with their community, as one mother stated: 'We believed in the power of information' (M.7). They built an extensive collection of government documents, scientific articles, books and press clippings. The knowledge was gradually enriched with Internet research and comparisons between the results reported by national and international scientists such as Professor Philippe Grandjean and Linda Birnbaum of the National Institute for Environmental Health Science, especially regarding the health effects and characteristics of contaminants. This process yielded several discoveries. For example, they determined that 'previous studies were conducted in the United States thanks to the C8 Science Panel

from which it resulted that PFAS were suspected of interfering with the human endocrine system and were correlated with cancer and other diseases' (M.21), traced back to other cases of contamination with PFAS throughout the world.

In summary, they began piecing together all the information like parts of a mosaic, discovering, for example, that during pregnancy, a mother passes PFASs on to the developing foetus through the placenta and later to the baby through breast milk, lowering her own PFAS levels. On the one hand, this evoked a sense of guilt, as expressed by one mother: 'If I had known earlier, I would try to protect my children even then. I could have medical tests avoiding then breastfeeding. This is in part my fault. I did not guarantee the safety of my children' (M.3). On the other hand, they were able to share this knowledge with other women so that they could take appropriate precautions. Over time, they started relating diseases such as cancer and thyroid dysfunction to PFAS contamination. Soon, they felt that they had become expert citizen mothers, as one participant reported:

I believe we have become great experts in PFAS. We address topics ranging from contaminated food to limits on water, from the development of the contaminated Miteni site to the European Drinking Water Directive, and the consequences for human health. I could take an exam on the subject tomorrow without any problem! (M.16)

At the community level, their practices were to share and promote knowledge on PFAS contamination to create a common perspective, such as regularly updating their family doctor on scientific studies about the consequences on human health, starting an educational programme in schools, sharing knowledge with communities and organising meetings in parishes with the help of priests.

As MammeNoPfas, they spoke to local and regional health officials, asking about safeguards to ensure some measures, such as upgrading the water filters installed some years ago, spillage controls at the Miteni site, construction of new aqueducts and conducting epidemiological studies. They started putting pressure on the authorities in the Veneto Region to take protective actions for all involved citizens and the environment. They never gave up, even when the dialogue between the diverse parties was extremely difficult, for example, for the construction of new aqueducts, due to the constant rebounding of responsibilities, especially among the regional, state or local municipalities, as described in the following extract:

To overcome the impasse, we promoted a meeting at the Ministry of Health. I remember there were hours and hours of dialogue, mediating to the point of exhaustion, until an agreement was reached with parts that had made specific commitments, which were subsequently financed. (M.17)

Through the gained knowledge, the mothers also learnt the power of speaking from their experience; many of them acquired the skills to address increasingly complex issues and, as such, challenged collective ignorance. For example, a mother was invited to attend the Second National Conference on PFAS at Northeastern University in Boston, which was attended by numerous scientists from different countries. Two other mothers were invited to speak at seminars for students at Padova University to increase their environmental education and technical knowledge in the field of PFAS contamination. These events were further strengthened by establishing collaborations with universities and scientific associations, becoming mentored undergraduates and participating in research programmes. Finally, they applied their technical skills to documentary filmmaking, television programmes and journalist investigations.

#### 6.1.4. Community Practices

Undoubtedly, the lives of the mothers involved in this study changed when they found their children to be contaminated with PFASs through the health surveillance programme and started realising that 'something is wrong and unclear' (M.9). However, they became accidental activists when they reached a turning point, a disjunctive moment and a

transformational intersection at a public meeting that took place in Lonigo, a municipality of the Red Area, in May 2017. On that occasion, the data on PFAS contamination in the Veneto Region, drawn up by the Italian Parliamentary Commission of Inquiry into Echo Crimes, indicated the gravity of the situation. It was unexpected for most mothers: 'We never expected this, a completely compromised polluted aquifer! A pollution that has been going on for decades with the silence of institutions' (M.4). In that circumstance, they also discovered that many workers of the Miteni Company had been working closely with highly toxic substances for decades. It was 'a very difficult reality to accept' (M.18), as indicated by a mother. Initially, they acted, motivated by their role as mothers in the private sphere of their families. However, as they came to view the various forms of injustice that embrace the contamination phenomenon, in which their children, families, community and workers were affected on a large scale, they became activists in a more public arena. As the facts about PFAS contamination became well known to these mothers, the knowledge they acquired was exported outside their inhabited spaces to public spaces, such as squares, schools, parishes as well as the Internet, through social media channels, as reported by a mother: 'to get the issue and how we live to the public' (M.13). A significant milestone that marked their success as activists was the 'PFlowers March' on 14 May 2017 with 2000 people in front of the Miteny site, asking for the safety of water, the territories and the inhabitants. A mother reported that 'after this manifestation, we started a fight that leads us to ask for meetings with the representatives of the institutions' (M.3), lobbying at the local, provincial and national levels.

In 18 months after the march, we have made more than 120 meetings with mayors, local and regional health leaders, various chemical experts, doctors, priests, and the bishop of Vicenza. We also received support from the Holy Father, who expressed his solidarity with us. I remember that we sent about 300 mails to the Miteni Company attaching the blood results of your children and the PFAS levels in the water of private wells. Our scope was to inform, request PFAS limits, and communicate how we felt. (M.18)

### Mobilisation

On 8 October 2017, an unprecedented mobilisation took place in Lonigo Municipality in the presence of over 10,000 people, including 50 mayors and presidents of Vicenza and Verona.

It was an important event, a watershed between a before and an after. We started in September by preparing informative documents, such as flyers and small handbooks, with the help of a 'father NoPFAS'. We distributed these materials to schools, various associations, and reached out lawyers, doctors, and others. (M.1)

As a result of their efforts, the authorities imposed a lowering of the PFAS limits in drinking water across the Veneto Region, adopting the technical zero in the Red Area. Additionally, the filters installed in 2014 were upgraded with a replacement plan to ensure safe water, with filters being changed every 40 days. Mobilisations continued even later in various public spaces, such as in Venice in front of the seat of the Veneto regional government, asking for land reclamation. In Trissino, in front of the Miteni plant, recognized as the source of contamination and a symbol of the perpetrated damage, further protests erupted, especially after the management claimed damages from the state for lost earnings due to the PFAS contamination. To this, the mothers reacted by publicly expressing their indignation 'about what we were denied: a safe water' (M.23). This is another reported example of the event:

It was a wonderful and fulling day! Around 5000 people joined us. We organized workshops for adults and children, a Mass was celebrated by a priest dedicated to peace. Our message was to defend Mother Earth from environmental crimes. (M.22)

More mobilisations took place in front of the Vicenza public prosecutor's office. In August 2018, the mothers stayed there for 5 days and 4 nights with members of other associations 'fearing that Miteni remained unpunished, we asked justice in its condemnation, land reclamation, compensation for damages caused, seizures of its headquarters' (M.12), as reported by a participant—a path that led them to a process against Miteni Group.

The participants indicated that these mobilisations helped them build informal networks with other associations and interested citizens, facilitating mutual support and information sharing. Over time, these networks became a powerful foundation for activist mothers, which allowed them to develop a sense of meaning and connection with others that 'what we were doing was right' (M.15).

### Legal Arena

All participants described the execution of the trial against the Miteni Company as an opportunity to 'change circumstances'. For the mothers, the turning point that initiated their epistemic practice in a legal arena happened in October 2018, when Miteni unexpectedly decided to declare bankruptcy and close the seat, suspending production activities. According to the management, this decision was made due to the financial costs derived from preliminary investigations into alleged crimes against the company that had an important impact on its budget and made it difficult to obtain credit from local banks, hampering the company's reputation. Following this event, workers and trade unions organised a series of strikes, and the mothers, 'concerned, with the fear that the company eluded various responsibilities including damage to the health of citizens and reclamation' (M.10) (as stated in an interview), decided in December 2018 to ask the lawyer Matteo Ceruti to represent them as civil parties. One of them declared, 'I realized that I couldn't live this way anymore, I have to do something' (M.5). This social role proved critical for them, as the following extract describes:

In the process, I am a civil party asking that the responsible are condemned, ensuring that such disasters are not repeated. Overall, it must be an example for the industrialists, because they must see that the pollution is for all, it is a major crime towards the community, towards the health of citizens. Additionally, to bring out the truth at the public level, raising public awareness of the harmful effects of PFAS contamination, including identifying those responsible even for omissions and lack of control. (M.6)

This process of reflection and action resulted in the participants producing a series of technical and scientific documents to be attached to ongoing investigations. For example, a mother was engaged in the Italian translation of scientific medical documents written in English. Another mother maintained the relationship between the lawyer and the civil parties, collected documents and signatures and updated them on the various phases of the trial. Another mother remained in touch with the experts. 'It will be a complex journey, but we undertake it for our children, our community, our land and all the people who suffer from this experience' (M.7), as reported by an interviewee.

### Epistemic Community

Overall, these mothers viewed themselves as active members, creating a bottom-up campaign within the community; they thought of themselves as regular women and mothers carrying out necessary tasks, which, for them, meant setting a course of action against the contamination. They also did not anticipate the immense community mobilisation that they attracted. However, this success came with its own challenges in the back end. For example, they experienced physical and cognitive fatigue while managing contacts and projects. One mother said that, for her, 'one of our efforts was to communicate with journalists. Although I'm not a graduate, I found myself speaking with them and writing press release texts' (M.19). Another mother described her commitment as follows:

After a day of work, often as late as midnight, we would meet to organize and coordinate the campaign and fundraising efforts. Fundraising was one of the major concern, especially for covering appraisals and technical advice needed for the legal process, as we are all volunteers with no financial support. In addition, I answered calls from other parents seeking information and helped disseminate updates, such as developments in the court case. (M.3)

All participants acknowledged that they were wrapped up in a difficult personal situation and had to manage family and work needs simultaneously. Although they had full support from their husbands, as well as their families, they had to learn to manage the delicate balance of work, activism and family life with care, especially at the biggining. In the following quote, a mother described her commitments:

I managed the time commitments associated with work, running the household, and attending meetings with great care. Initially, the load was overwhelming, especially with the added stress of extensive community work and feelings of guilt about being away from home many evenings and having to respond to WhatsApp messages. One day, my daughter took my cell phone and removed me from all the WhatsApp groups without my knowledge, so I would not be overwhelmed by notifications and could spend more time with her. From then on, with each new undertaking, I carefully planned how to manage everything. (M.11)

The mothers were willing to reflect on what impact their commitment may have had on their family life, particularly their relationship with their children. 'My home became a site of delicate negotiation' (M.20), as described by most interviewees, where mothers balanced family life requests, mother responsibilities and group responsibility.

## 7. Discussion

In this study, we explored the experiences of a group of mothers exposed to PFAS contamination in the Veneto Region, Italy, who came together under the name MammaNoPfas to address this environmental disaster. In such situations, available knowledge and communication are key to enabling the affected community to deploy adaptive resources and promote resilience (Norris et al. 2008). After the discovery of the damage, the health authorities invited the citizens living in the contaminated area to participate in a health surveillance programme to receive accurate and detailed information about the danger and current risk, as well as any guidelines on the appropriate behaviours to adopt. Properly conveyed information increases the degree of cohesion and an effective collective response. However, as in the case of PFAS contamination in Veneto, citizens who are victims of environmental pollution often find themselves in a situation where the degree of uncertainty is the highest and the information gap is significant. Furthermore, the dissemination of graphs, tables and numbers by local administrative and health authorities risks creating even more confusion because they are often written in a technical language that is incomprehensible to the vast majority of citizens. This renders them useless or, worse, misleading, creating an experience of confusion and disorientation (Slater et al. 2014). Thus, filling the data gaps and responding to the need for information are factors that fuel and facilitate citizen mobilisation. By interacting with and supporting each other, citizens move towards activism. These networks help the entire community understand what has happened despite the highly confusing context (Edelstein Michael 2018). The mothers in our study, like other accidental activists (Ollis 2020), had never participated in activism before. They had not studied theories of social change and processes of social influence, nor were they familiar with sociopolitical treatises to promote public participation and collective protest actions. They were ordinary mothers who, in general dismay, discovered that they and their family members had been exposed to PFAS contamination.

Overall, this study's results clearly demonstrated that, after an initial personal disorientation exacerbated by intense emotional tension, these mothers embarked on a difficult and tortuous journey of knowledge. The first spontaneous contact at an interpersonal

level and in small groups occurred in a climate of collective ignorance, exposing these mothers to stigmatisation in their search for answers. As shown by the bystander effect (Latané and Nida 1981), if most of the community remains inert, then there is probably nothing to really worry about. The minorities who want to understand and continue to seek and demand information risk exposing themselves to negative judgements. Our analysis revealed a series of highly painful and inevitable challenges. In addition to dealing with daily challenges related to exposure to toxic substances on personal and family levels, these mothers had to manage the marginalisation inflicted by the majority. Since contamination in Veneto is primarily associated with the activity of an industrial plant located in the area (WHO 2017)—which, for decades, produced PFASs through electrochemical fluorination—and since the same industrial products were used in various production activities in the area, MammeNoPfas, with their actions aimed at understanding the environmental risk, disrupted the established economic interests, resulting in them being labelled ‘hysterical, chemical-phobic housewives’. An almost immediate consequence of the negative labelling process is a general lowering of the status of a person or group associated with undesirable characteristics that reduce their status in the eyes of those who stigmatise them and the public. Thus, the stigmatised are more likely to be delegitimised, making it much more difficult for them to speak up and have their issues and ideas accepted (Link and Phelan 2001).

Despite these obstacles, the activism of MammeNoPfas, triggered by a crisis and the sudden concern for their and their families’ health, was driven by emotional agency and a close connection to the problem. For these mothers, the emotional bond with their family members was a strong motivation to act, understand and better manage the situation. Generally, the practices of accidental activists are both social and embodied. In fact, they are practices integrated into daily interactions, where learning is intrinsically connected to emotions and guided by the desire to address the problem and the need to promote social and environmental justice (Ollis 2020). As our study shows, learning occurs through mutual social support and is embedded in interpersonal interactions. The urgent need for each mother to understand and know was fulfilled through socialisation and communication with other mothers. The ‘place’ of learning was, thus, the dialogical exchange between the mothers, marked by concerns, questions, searches and answers. This exchange quickly developed a level of knowledge that made these accidental activists experts in PFASs. Mothers who had no prior experience in public speaking or dealing with the media are now able to share their experiences during press conferences and even participate as invited speakers at international conferences.

The better the epistemic capacities, the better a group’s or community’s ability to participate in the public sphere. Our study shows that the skills acquired by MammeNoPfas enabled significant participation in environmental and health issues. Social mobilisation (marches, petitions, awareness campaigns in schools, etc.), fighting for legal justice against those who poisoned their land and bodies (contributing, through their participation and testimony, to the unfolding of a criminal trial against the polluting company) and establishing themselves as an epistemic community are the three main dimensions characterising the struggle of MammeNoPfas. Having fought and overcome stigmatisation processes, they can now present themselves in various spheres of society as credible and reliable interlocutors. They organise public events, speak to students to raise awareness of PFAS risks and engage directly with local, national and European authorities to impose PFAS limits on the environment. They are respected and reliable witnesses during hearings in the trial against the polluters of the Veneto Region. Most importantly, they have become a genuine epistemic community; they continue to generate knowledge, working closely with academic researchers, and have become a primary source for information on PFASs, both regionally and nationally. Our study clearly shows that MammeNoPfas meets all four necessary conditions outlined by Werkheiser (2016) for an epistemic community: acquisition, maintenance, adaptation and knowledge development. In their case, this knowledge and capability pertain to environmental contamination by PFASs.

## 8. Conclusions

In most cases of environmental pollution where a minority group takes action, the citizens involved have no prior theoretical or practical knowledge of the issues they face. However, membership in the group liberates them from collective ignorance of existing problems and initiates a process of 'cognitive liberation'; from hopeless submission, they move towards the possibility of challenging oppressive conditions through learning. Activist groups build a narrative of events by documenting the danger and expanding their foundational knowledge. They engage with scientists, public health officials and sometimes lawyers to inform themselves and act consciously. In addition to the ability to generate knowledge on new topics, activists also see it as their duty to share the acquired information with the rest of the community. Physical and virtual meetings, pamphlets, websites, videos, social media and other tools are used to disseminate the gathered documentation. Thus, people engaged in practising ecological citizenship impose a true transformation of epistemic capacity in the closest public sphere, where the intertwined relationship between expert scientists and informed citizens fosters a renewed understanding of knowledge. What emerges is the so-called 'citizen science' (Clark and Illman 2001), which refers to a form of knowledge produced by citizens from the 'bottom' of their concrete experience (in contrast to the 'top-down' theoretical position typically attributed to experts), and a science that is fully equipped to address the needs and concerns of the citizens themselves. The path that opens up is that of 'civic environmentalism' (Landy et al. 1999), which is the collection of all initiatives supported by citizens, landowners in contaminated areas and institutions, with the collaboration of experts, to address specific and localised environmental problems. This way of producing knowledge, by including multiple viewpoints and maintaining the complexity of perspectives, eliminates the exclusive celebration of progress as the guarantor of wellbeing and stimulates a new form of thinking, steering efforts towards a process of collective responsibility.

This study is certainly not without limitations; the participant group is small (23 interviewed) and self-selected, so it is possible that the research includes mothers with particularly strong emotional agency. Additionally, all participants are female, so it would be appropriate for future research to also consider male perspectives. Nevertheless, these results can be useful for community services to develop initiatives that promote conditions for active public participation in environmental justice issues.

**Author Contributions:** Conceptualization, M.M. and A.Z.; data curation, M.M. and A.Z.; formal analysis, M.M.; investigation, M.M. and A.Z.; methodology, M.M. and A.Z.; supervision, A.Z.; writing—original draft, M.M.; writing—review and editing, M.M. and A.Z. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research received no external funding.

**Institutional Review Board Statement:** This study followed the American Psychological Association Ethical Principles of Psychologists and Code of Conduct and the principles of the Declaration of Helsinki, and was approved by the Ethics Committee of the Università degli Studi di Padova (Protocol Number 1D4BA484CC28FCDA6984C4F21E59DEA6).

**Informed Consent Statement:** Informed consent was obtained from all subjects involved in this study.

**Data Availability Statement:** The data presented in this study are available upon request from the corresponding author.

**Acknowledgments:** The authors thank the reviewers for their thoughtful comments and efforts towards improving their manuscript. The authors would like to express sincere gratitude to the members of MammeNoPfas for their commitment to environmental issues.

**Conflicts of Interest:** The authors declare no conflicts of interest.

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